**The University of Texas Permian Basin**

**EENG 4460 Senior Design**

**Final Report**

**Title Page**

See the attached Cover Page for the format of the report’s title page.

**Executive Summary**

An executive summary is your entire research paper condensed into two well-written pages. It should have a small introductory paragraph, separate paragraphs for each section of the paper (method, analysis, results, etc.) and then a short conclusion. Each paragraph should probably be no more than 5-6 sentences and should be separated by subheadings.

Basically, an executive summary should be the document your manager could read in less than five minutes and understand what you did, how you did it and why it is important.

**Table of Contents [3]**

**List of Figures**

Figures should be described in the text **before** its placement in the document. Every figure should be cited directly in text (e.g., “Figure 1 shows …”). Figures should be numbered starting from 1. Figures should be numbered in order of their citation in text. Its figure caption should be placed below the figure using Times New Roman and font size of 10. Figures should be compact meaning try to reduce white spaces in the text. This will take optimal space and text font size will not be reduced if size of the entire figure is to be reduced for placement in other publications. Figure information should be economical in space, neat, legible, axes labeled and within margins. Example of figure caption:

Figure 1: Describe what this figure is all about

**List of Tables**

Tables should be described in the text **before** its placement in the document. Tables should be numbered starting from 1. Other tables should be numbered in order of their citation in text. Its table caption should be placed above the table using Times New Roman and font size of 10. Tables should be compact meaning try to reduce white spaces in the text. This will take optimal space and text font size will not be reduced if size of the entire table is to be reduced for placement in other publications. Table information should be economical in space, neat, legible, axes labeled and within margins. Every table should be cited directly in text (e.g., “Table 1 shows …”). Example of table caption:

Table 1: Describe what this table is all about

**Introduction:**

Problem Statement

Identify the need of the problem as indicated by stake holders such as customer, industry, and sponsor or self-proposed. Clearly write ¾ to 1-page covering following:

* briefly and clearly state the need to be met
* not provide a solution to the problem
* provide supporting statistics or anecdotes
* describe current limitations
* describe any supporting processes.

**Problem Formulation:**

Objectives

Write at least 3-4 objectives of the project as bullet item. Describe details of these objectives in text form. Clearly write at least 1-page covering following:

* Summarize what is being proposed to meet the need
* Provide some preliminary design objectives
* Provide a preliminary description of the technical solution, avoiding a detailed description of the implementation.

Present any design constraints envisioned at this time or may encounter in future.

Introduction to your project as what is project is all about, what it will do its features and benefits. It should be supported by a conceived block diagram showing various building blocks in terms of inputs, outputs and sub-systems interacting with each other.

**Project Specifications**

Write a clear set of design specifications for the project in terms of marketing and engineering requirements. The design specifications should be clear concise statements with a specific metric and an appropriate value. Marketing requirements are set of statements of the customer’s needs. Engineering requirements are set of short statements that address a technical need of the design. They satisfy the needs of a customer or end user. Write both marketing and engineering requirements in bullet form.

Engineering requirements should have following properties:

1. Abstract
   1. Description of capabilities and conditions; should be numerical.
   2. Explains what it does **not** how it does it.
2. Verifiable
   1. There are ways to **measure and demonstrate** that it meets the needs.
3. Unambiguous
   1. Short and **clear**
   2. A one-sentence description of the requirement.
4. Traceable
   1. It can be **traced** to the original customer need.
5. Realistic
   1. Must have **benchmark(s) and realizable.**
   2. Realistic targets – tolerance (e.g.,+/- to ppm)

Problem Requirements Specifications is a dynamic process and is likely to evolve through an iterative process. It may be combination of discussion with the customer and or uncovered things that are not feasible for the realistic design. The changes in the requirements must be accepted by the customer.

**Objective Tree** – a hierarchical and graphics-based representation of the needs based on functional similarity with the relative weights of the needs identified.

**Detailed design**

State of the art in the form of literature review

Research the internet for technical papers, reports, patents and textbooks. Determine what has been done in this area. Provide a summary of similar designs, processes or technology with strengths and weaknesses. Indicate what is available and what is not available. Provide a brief summary of your findings including any comparison.

Concept Generation:

Discuss team brain storming session and show various design concepts that were generated. Show alternative designs via figures, sketches and tree diagrams.

Show that design methods (at least three) were used to generate several conceptual solutions to the design problem. Draw sketches or tree diagrams to describe the alternatives that were produced by this effort. Perform strength and weakness analysis, analytical analysis or Pugh concept selection. Show analytical data for reaching to a certain design. Discuss why alternative solutions were rejected. Justify that the proposed design is the optimal solution and meet all functionality necessary to meet all constraints and requirements.

**Design Description**

Show proposed design in details. Discuss concepts, which have been used to solve the design problem. It should be supported by block or other diagrams and component values. Show any mathematical model or equations for the design and any engineering analysis. Discuss all major subsystems, their features and purpose. Present all mathematical formulations, assumptions and parameters used. Show results of analysis. Your design description should be clear enough for the reader and one could repeat the design. All equations should be neat, legible, with proper use of italics, and bold. They should be centered or indented consistently. Numbered in sequence and according to same scheme (whole number or single-decimal) as figures and tables, but in a sequence independent of figures and tables. Use parentheses both in display and in text citation. Numbers are flush right. Present all engineering analysis used in the design. Discuss formulations, assumptions and used parameters. Provide justification that the design will not fail. The design description should be in such details that it could be repeated. Show that design will meet desired goal. Draw flowcharts for the required software. Show block diagrams in a hierarchical fashion on a single page. Use other pages to show sub components or circuits. Full low-level diagrams can be included in the Appendix. Explain all your design, various diagrams and flowcharts.

**Iterative Nature of Design Changes (1-page)**

Write about any changes were made during the course of this project due to changing circumstances of any kind. Use above heading.

#### **Cost Analysis**

Perform cost analysis and show cost of prototype including labor cost. Provide a bill of material including full part list, their part numbers, name of the manufacturer or distributor and cost. Provide total cost of the prototype. Bill of material should be in a form so one is able to find these parts and assemble the product. Custom parts must also be specified. Details of the parts or data sheets should be included in the appendix.

**Ethics and standards (one page with separate headings)**

Discuss ethical issues that have been considered during the design process. Discuss that the design is ethically responsible. It is safe to the public and the environment. It also addresses any global issues. Discuss what standards have been followed in this design. Provide applicable or potential standards will be applicable to the proposed product.

**Hazards and Failure Analysis (one page)**

The proposed design should be safe to the people and to the environment. Safety consideration during the use of this product should also be described. Discuss how safety consideration were employed and document any safety consideration during the use of the product.

**Management of the project**

Discuss management of the work and team during the design and prototype phases of the project. Document responsibilities of each team member. Show in a tabular form listing team members and their contribution to the project.

**Prototyping**

Discus the time line during the prototyping phase. Show team member responsible for constructing the assigned component or simulating the function. Show that team members accomplished prototyping phase in timely fashion. No part of the project was delayed.

**Testing Verification**

Develop a test plan during the design phase of the project. Show details of testing and verification phase of the project. Show that the project meets the desired requirement. Provide test results via tables or appropriate graph of data collected during the testing phase of the project.

**Environment and Global issues**

Discuss environment and global issues related to your project about 1-page.

**Conclusions**

Including – lesson learned, problem encountered and future work

Write the most important facts and discuss their significance. It should be self-contained and independent of the main body. It should include some logical conclusions for this work and summary of key points. You should include a section on future work that is possible. Some examples can be different design approach, additional features that can be added and your opinion on results. Length should be one page each for conclusions and future work.

Write one page each on problem encountered, lesson learned, and future work during the course of this project work. This will help that future students should not be encountering similar problems and we can try to help. Write one page on lesson learned during this project.

**References**

All references are cited in the text, and every citation corresponds to an entry in References. Number your references in order of citation in text. Use brackets and IEEE style. Example [1].

**Appendices**

Include additional material such as program code, data sheets, detailed test results and any other information. Items are included in appendices, which are not critical to the design focus. You can include details of modeling and simulations, details of testing protocols, detailed test results, certification of performance, details of economic analysis, alternatives evaluated but not selected, etc.

Following are formatting instructions for your report.

1. Title page unnumbered (counts as i)
2. Preliminary pages in lower case Roman numerals
3. Chapter 1 starts on Arabic page number 1, and the rest of the report, including appendices, follows from that. (Do not use independent page numbering for appendices.)
4. Each chapter starts on a new page.
5. Preliminary sections (abstract, contents) have chapter status graphically, but are **not** included in the table of contents
6. Numbering of chapters and sections is logical, and their style (e.g., capitalization, font size) is consistent.
7. All pages numbered consecutively after that; each chapter begins on new page
8. Number your pages at the bottom center. Transmittal letter and title page do not have page number.
9. Use a clear and logical heading style to identify the main and subsections of the report.
10. Use figures or tables whenever information is easier to understand in graphical or tabular form.
11. Table captions and numbers go above the table. Number all your Tables as 1, 2 etc.
12. Figure captions and numbers go below the figure. Number all your Figures as 1, 2 etc.
13. Figures or tables taken from other sources must be properly acknowledged.
14. Use Microsoft word for writing of your report with Times New Roman font 12 point.
15. Use grammar check and should be proof read by all members to eliminate errors. Your report will be graded accordingly if there are typos, sloppy work or does not follow specified format.
16. Use double line spacing and use a consistent amount of white space between sections and subsections. Use 1” margin on all sides. Text is left justified, skip line between paragraphs.
17. Provide flowchart for your software in the main body of the report and give figure numbers. Flowchart should be on one page and should be readable. Break your flowchart in logical fashion when it is presented on multiple pages. Source code of your program will be in the appendix and submitted as an electronic copy.
18. Each member of the project team contributes a proportional share of the actual written material. Your instructor will grade reports for language and format.
19. Take color pictures of the team standing along sides on poster presentation during Undergraduate Research Day on April 14, 2023. Include photographs in color in your report as evidence of your participation in poster day. Include submitted abstract in the appendix.
20. Print final report as double sided possibly in color. Bound your report in an economical fashion. Turn in hard copy on the due date. Turn in electronic copy of the final report in Microsoft word and power point presentation. Email them to [Mohsin.jamali@utpb.edu](mailto:Mohsin.jamali@utpb.edu). Use file name as:

Final\_ReportAbbreviated\_Project\_Title\_TeamLeaderName.doc

Report\_1Abbreviated\_Project\_Title\_TeamLeaderName.doc

CDR\_Abbreviated\_Project\_Title\_TeamLeaderName.doc

Abbreviated\_Project\_Title\_Name.ppt.

1. No pdf copies will be accepted.
2. Provide source code of your program as a single electronic copy with file name as:

Abbreviated\_Project\_Title\_Name.extension

1. Presentation guidelines will be provided in a separate document.

**Additional Writing considerations [3]**

* Write in a formal style and neutral tone without letting your writing become dull and lifeless. Use active voice as much as possible, and employ variety in sentence structure. Avoid wordiness, affectation, awkwardness, and gobbledygook. Intensifiers (adverbs modifying adjectives) and other modifiers should be used very sparingly. Be quantitative when possible. Do not write as a story.
* Use past tense to report transitory results and completed actions (“The resistance was 10 Ω until we replaced R1”) and present tense to report final results and discussion (“The trigger fall-time is 15 ms, which is well within the design specifications”). Avoid frequent and arbitrary changes in verb tense.

## **Numbers**

In general, use words for numbers up to 10 (e.g., one, two, three), and use numerals for numbers 10 and up.

Exceptions:

* Always use a word at the beginning of a sentence: “Forty trials were run.” (You may wish to recast as “We ran 40 trials.”)
* Unless at the beginning of a sentence, quantities with units of measure are always numerals: 3 mm, 5 V.
* Numbers used as nouns are usually set as numerals: Chapter 3, sample 16, device 2.
* When comparing, within a paragraph, numbers that are above and below 10, make them all numerals: “In trials 1 and 2, we completed 8 and 15 runs, respectively.”
* If two numbers that would normally be set as numerals appear next to each other, it may be best to change the lowest number to words: “We completed sixteen 45 min trials.”
* In some cases, it may be clearer to spell out zero and one than to use numerals 0 and 1.

## **Abbreviations**

Abbreviations should be defined the first time they appear in both the abstract and the main text. After that, only the abbreviation is necessary, though you may choose to repeat the definition for a new chapter or after an extended period of disuse of the abbreviation. Provide a list of abbreviation just after list of tables.

## **Numbering, Citation, and Placement**

Number figures, tables, and displayed equations in *independent* sequences according to one of two systems: whole number (1, 2, 3 …) or single-decimal (1.1, 1.2 … 2.1, 2.2, etc., where the number to the left of the decimal corresponds to the chapter number). Use the same system for all three, but do not integrate them in one sequence. Do not create a multiple-decimal numbering system!

In the text, cite every figure and table *directly* (e.g., “Figure 1 shows …” not “the following figure shows …”). Citing (and numbering) equations is optional.

Senior design report should provide various components in the following order:

|  |  |  |
| --- | --- | --- |
| Item # | Title | Explanation |
| 1 | Letter of Transmittal | Write a formal letter to tell client or course instructor as what is included in the transmittal package. Prepare this letter after the report has been completed. |
| 2 | Title page | Top sheet in report. See attached. Statement of confidentiality if applicable. |
| 3 | Executive Summary | It is a brief summary of the design report describing key features such as results, design overview, cost, schedule, etc. Limit it 1-2 pages. |
| 4 | Acknowledgements | Thank your sponsors, technical advisor, client advisor, and anyone else who has supported you during this work financially, morally, provided equipment, space, or advice. If it is a part of the grant that provide the grant number (Ask your advisor) |
| 5 | Table of Contents | It should include the major report sections and the page on which these sections begin. |
| 6 | List of Figures | Provide this list with figure number, figure caption and its page number |
| 7 | List of Tables | Provide this list with table number, table caption and its page number |
|  | List of Abbreviations |  |
| 8 | Introduction | Provide background information, historical background, motivation including problem statement and formulation as described in the beginning of this document. |
| 9 | Project Specifications | This section will cover marketing and technical requirements |
| 10 | Detailed Design | This section will cover literature review, concept generation, evaluation of various design alternatives and proposed final design. Include testing plan |
| 11 | Design implementation | Discuss implementation, construction and or simulation development |
| 12 | Performance evaluation and testing results | Show performance and test data under various conditions. Verify that the developed product meets the desired requirements. |
| 13 | Economic Evaluation | Show cost estimates and bill of material |
| 14 | Ethics and standards | Discuss ethical and societal concerns, Show applicable standards that are used in the design. Additional details may be appropriate in appendices. |
| 15 | Hazards and Failure Analysis | Safety concerns and how they will be mitigated, potential environmental impacts of design, potential health impacts (both positive and negative), environment issues. |
| 16 | Management of the project | Show the management plan as who has done what. |
| 17 | Gantt Chart | Show the timeline using Gantt chart as who will do what and its period. This should be done during the design stage. |
| 18 | Conclusions and future work | Statement of the project team's conclusion of the best course of action based on the completed design process. Detailed recommendations regarding how best to execute the design. Include future work. |
| 19 | Problems encountered | Discuss any challenges that have occurred and how you have overcome them |
| 20 | Lessons Learned | Write about what lessons have been learned. Writing about that we should have started early is not a lesson learned but lesson ignored. |
| 21 | References | Provide list of documents that has been consulted during the course of the work. Include patents, books, articles, YouTube videos etc. Provide website link whenever is available. Use IEEE format for citations. |
| 22 | Appendices | They include additional material such as program code, data sheets, detailed test results and any other information. You can also include details of modeling and simulations, details of testing protocols, detailed test results, certification of performance, details of economic analysis, alternatives evaluated but not selected, etc. Consult with your instructor. |

General Advice: A client/instructor will judge the overall quality of your work based on your report presentation. If your report is disjointed, disorganized, or containing significant composition errors they are likely to doubt your technical analysis. Take great care to make sure these non-technical aspects do not detract from your overall message.

References:

1. Guidelines for Senior Design Project Reports Tagliatela College of Engineering, <https://www.newhaven.edu/_resources/documents/engineering/pitch/student-resources/senior-design-guidelines-project-reports.pdf>

## Format for the Design Project Report (EE498 & EE499), King Saud University, Saudi Arabia

1. Preparing your final report for ECE 445, Senior design, The University of Illinois-Urbana Champaign.
2. EECS 4000 Senior Design Project Guidelines, The University of Toledo

**University of Texas Permian Basin**

**EENG 4460 Senior Design**

**Final Report**

for

Senior Design Project Name

First name, last name- Team Leader

First name, last name - Team Member

First name, last name - Team Member

First name, last name - Team Member

Department of Electrical Engineering

The University of Texas Permian Basin

Submitted to ---

Course Instructor

Dr. Mohsin M. Jamali

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Project Advisor

Dr. Mohsin M. Jamali

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**Submitted as part of the requirement for the course**

**EENG 4460 Senior Design**

Date of Submission

(use “Month Day, Year” format)